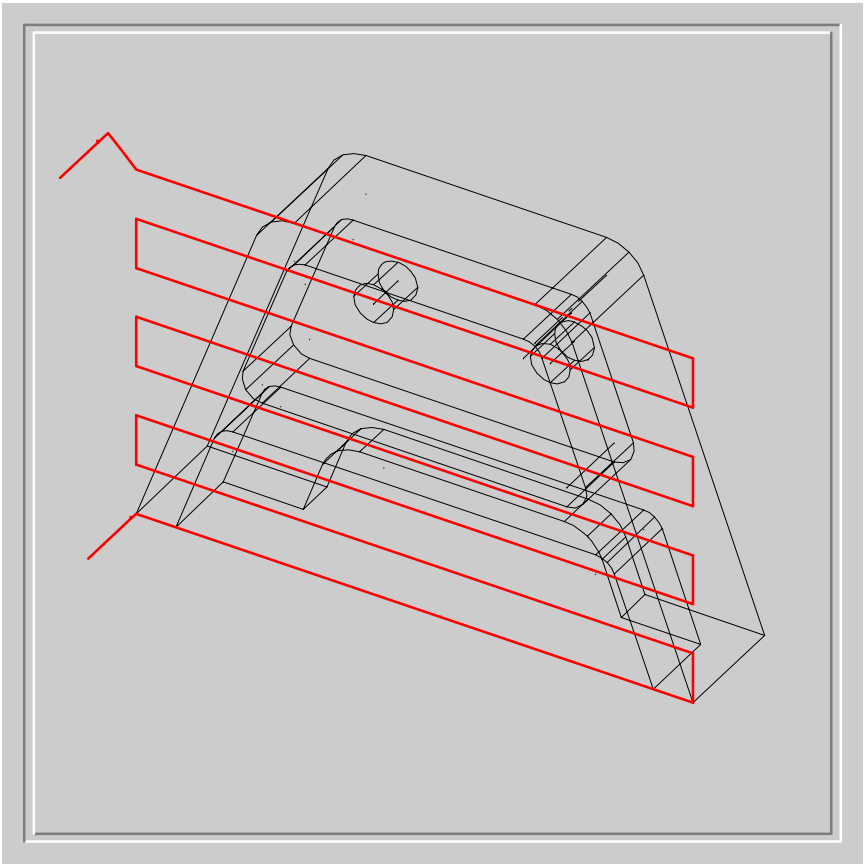


Creating Face Mill and Volume Clear Operations

I-DEAS™ Tutorials: Milling Projects

Volume clear is a 2 1/2-axis mill operation typically used to machine pockets and faces. Its primary purpose is to remove large amounts of material.

In this tutorial, you'll learn various techniques for using volume clear operations, including climb and combination machining. You'll also learn how to define stock for volume clear operations.

Learn how to:

- machine a face
- machine a cavity

Before you begin...

Prerequisite tutorials:

- all tutorials under the Modeling Fundamentals menu
- Introduction to Generative Machining
- Building a Setup Assembly
- Generating In-process Stock and Checking Validity
- Working with Tools and Tool Catalogs
- Picking Holes
- Setting Machining Parameters for Hole-making Operations

The file you need for this tutorial is distributed with the product. You must copy it into your local directory.

Move to the local directory where you want to copy the file. Then:

In UNIX:

```
cp $SDRC_INSTL/examples/nc/
tut_volume_face.arc .
```

In Windows use:

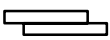
```
copy %SDRC_INSTL%\examples\nc\
tut_volume_face.arc .
```

If you can't copy the file, you may have to set up the variable needed to copy from the I–DEAS installation.

```
. sdrc_oadev
```

If you can't access the file, contact your system administrator. The file may not be installed.

If you didn't start I-DEAS with a new (empty) model file, open a new one now and name it volume.


File
Open


Model File Name: volume

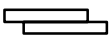

OK

Make sure you're in the following application and task:


Application: Manufacturing


Task: Generative Machining

Set your units to Inch (pound f)


Options,
Units


Inch (pound f)

Import the archive file that contains the parts and tools that you need to complete this tutorial. Importing an archive file can take several minutes. Be patient.

File
Import

Import Selections form


I–DEAS Archive File
OK

File Name Input form

Archive file name: tut_volume_face.arc
OK

The Manufacturing application quits, an informational message is displayed (the message will dismiss automatically), and the archive file is imported.

Import Archive File Status

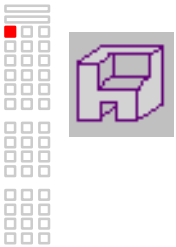

Check *I-DEAS List*.

Be sure to check the List region to be sure that the parts imported properly.

Dismiss

A second informational message is displayed (the message will dismiss automatically) and the Manufacturing application starts.

Create a job.



NC Job Create form

Job Name: Volume Clear

OK

Add the part to the job.

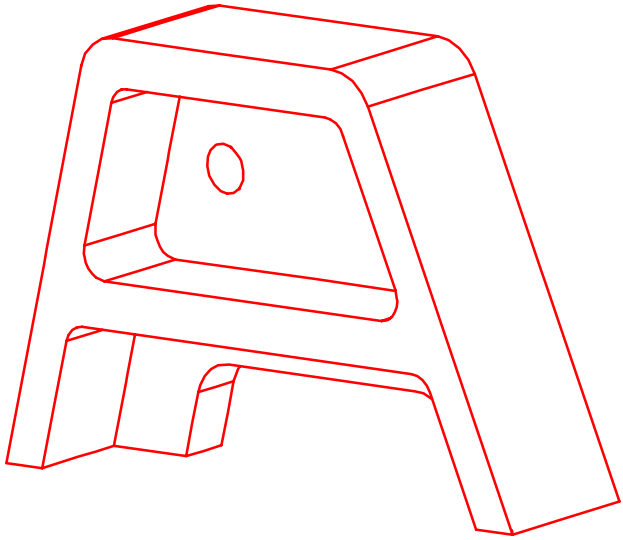
Get

From Bin/Library

Select Part/Assembly form

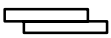
tut_volume

OK



The part is located relative to the global-space coordinate system with the origin at the center of the workplane. You can view the global-space coordinate system by picking *Workplane Appearance...,* then toggling on *Display Origin* on the *Workplane Attributes* form.

Recovery Point


File
Save

Warning!
If you're prompted by I-DEAS to save your model file, respond:

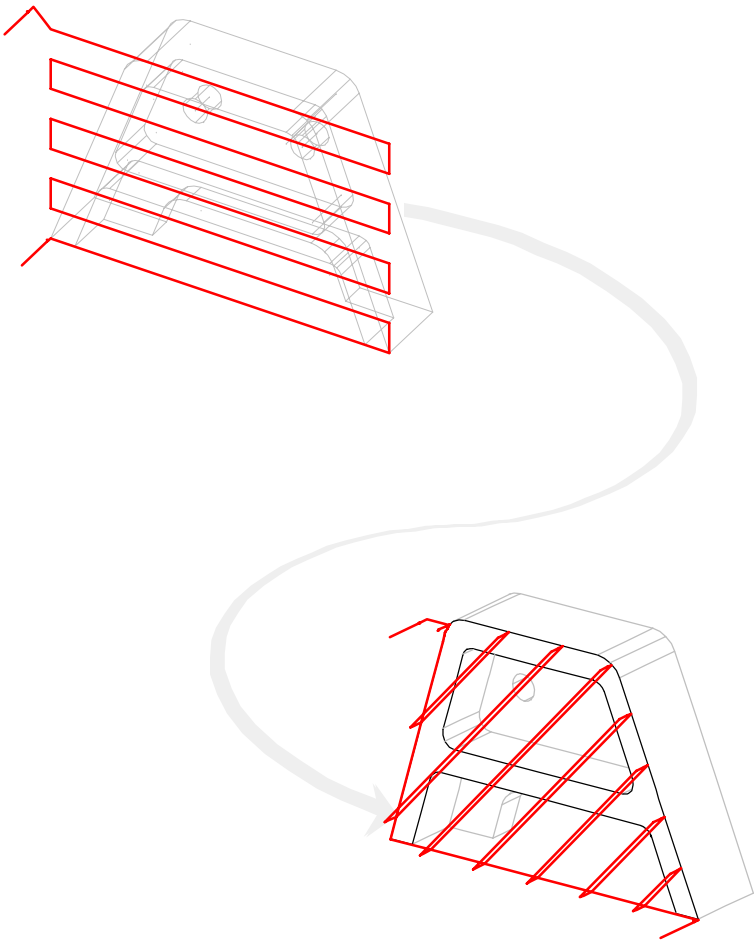

No

Save only when the tutorial instructions tell you to—not when I-DEAS prompts for a save.

If you make a mistake at any time between saves and cannot recover, reopen your model file to the last save and start over from that point.

Hint
To reopen your model file to the previous save, press Control-Z.

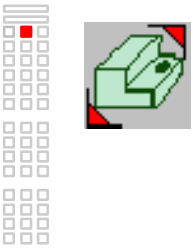
In the next steps, you'll create a face mill operation using a cut type of *Climb First*. Then, you'll modify the operation. You'll decrease the number of steps between the passes, and change the cut angle to 45 degrees.



You'll also learn how to define stock for a volume clear operation. Unlike other operations, you can specify the shape of the stock without a stock instance. In this tutorial, you'll learn how to define a bounding box and a footprint for the stock.

What: Create a face mill operation.

How:



NC Job Planning form

 OpGroup–1

OpGroup Specification form

Operation Selection form

 *Category: Milling*

 *Type: Face Mill*

 *Create*

Don’t close the Operation Specification form.

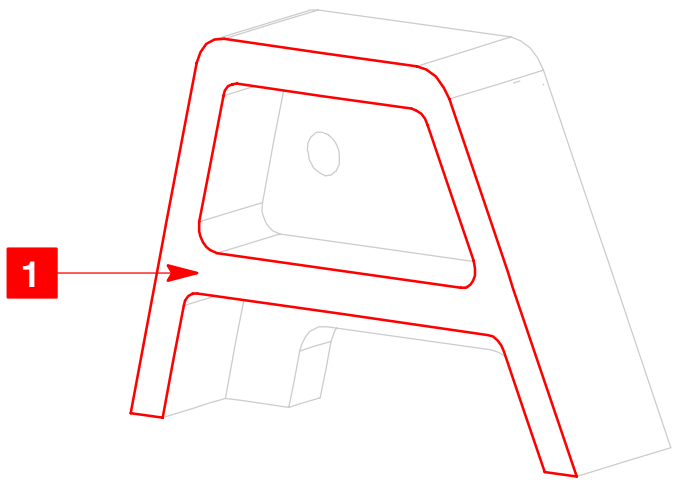
What: Name the facing operation and select the surface to be machined.

How:

Operation Specification form

Name: Face Mill Face

1 *F27*



Hint Use F1, F2 or F3 to rotate the part.

Don’t close the Stock Specification form.

What: Define the stock as a bounding box. A bounding box is a rectangle oriented around the selected surfaces in relation to the tool axis. The width of each side of the box is based on the largest lengths of the selected surfaces. You define the thickness of the stock by picking a top and bottom.

How:

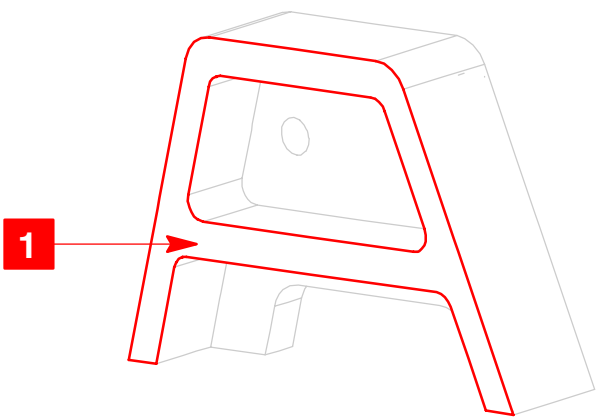
Stock Specification form

System Defined Stock (turn on)

Set Stock Area To: Bounding Box

Stock Top

1 *F27*



Stock Top: 0.1

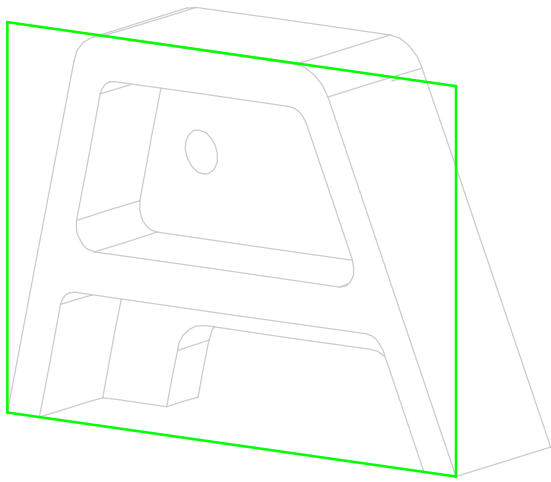
The top of the part is located at zero. You enter 0.1 to specify material to machine above this surface.

Don’t close the Stock Specification form.

What: Preview the shape of the stock.

How:

Stock Specification form



Things to notice

The bounding box encloses the outer edges of the part to define the stock.

OK

Don’t close the Operation Specification form.

What: Use a 1” diameter end mill to machine the surface.

How: You’ll open the project supplied with the software for this example.

Operation Specification form

Cutting Tool Specification—Mill form

Find...

Item Selection form

1” dia End Mill

OK

Cutting Tool Specification—Mill form

OK

Don’t close the Operation Specification form.

What: Define the cut parameters and finish allowance for the operation. You define the step between each pass as 70 percent of the tool diameter. *Climb First* keeps the tool in contact with the surface until it's completely machined.

How:

Operation Specification form

Machining Parameters: Cut form

Cut Pattern:Bi–Directional

Stepover Distance: 70

Cut Type:Climb First

Cut...

Allowances and Tolerances...

Machining Parameters: Allowances/Tolerances form

Default Finish: 0

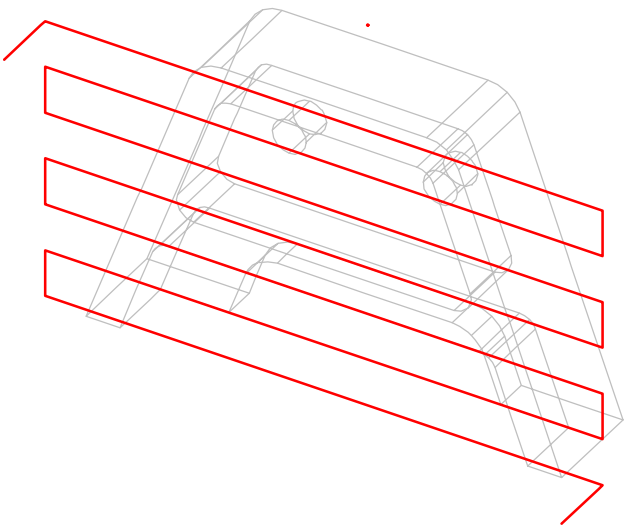
OK

Don't close the Operation Specification form.

What: Generate the toolpath.

How:

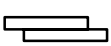
Operation Specification form



Things to notice

The tool cuts in a zig-zag cut pattern and doesn't retract until the surface is machined. Also, notice that the toolpath extends beyond the edges of the selected surface. Remember, the tool cuts not only the selected surface, but it machines the bounding box that you defined as the stock.

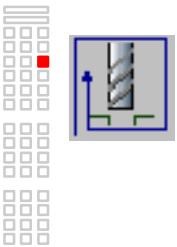
Recovery Point



File
Save

What: Modify the shape of the stock as a footprint. A footprint is a 2D profile of the selected surfaces in relation to the tool axis. The software traces the convex edges of the selected surfaces to define the shape of the stock.

How:



Operation Specification form

Stock Specification form

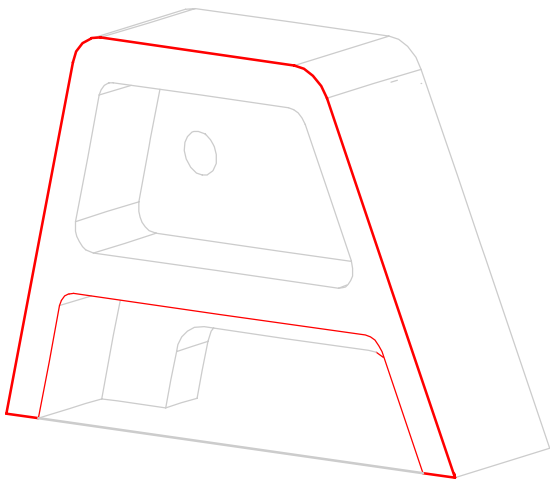
 *Set Stock Area To: Foot Print*

Don’t close the Stock Specification form.

What: Preview the shape of the stock.

How:

Stock Specification form



Things to notice

The footprint follows the outer edges of the selected surface. Concave areas of the surfaces are ignored to form a convex volume.

OK

Don’t close the Operation Specification form.

What: Modify the cut parameters. You'll shorten the distance between the passes, change the angle of the cut, and specify machining in the climb direction.

How:

Operation Specification form

Machining Parameters: Allowances/Tolerances form

Allowances and Tolerances...
Cut...

Machining Parameters: Cut form

Stepover Distance: 0.9

You define the steps as an absolute distance of .9, instead of a percentage of the tool diameter as in the previous operation.

Angle: Automatic...
X–axis...

Angle: 45

Clearance From Stock: 0.5

Cut Type
Climb First

OK

Don't close the Operation Specification form.

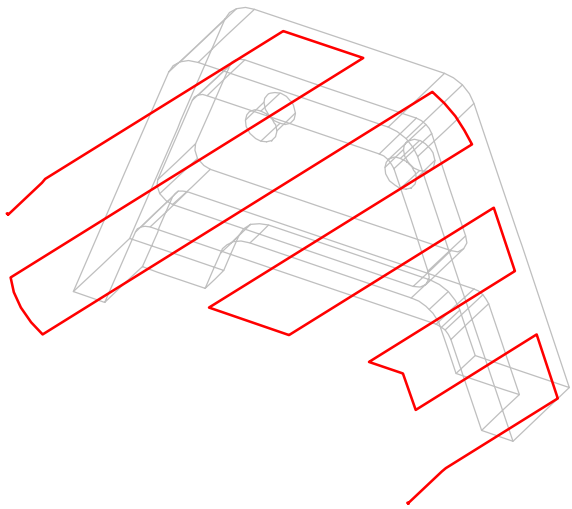
What: Regenerate the toolpath.

How:

Operation Specification form

I-DEAS Warning

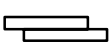
 *OK*



Things to notice

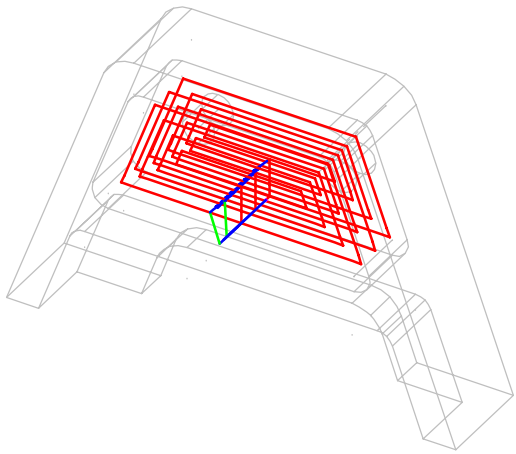
Because the cut type is climb only, the tool cuts in one direction only and must exit the part after each pass is finished. The toolpath follows the shape of the part because you redefined the stock as a footprint. The toolpath also extends beyond the edges by the .5” you set in *Clearance From Stock*.

Recovery Point

 *File*
Save

In the next few steps, you'll machine the upper cavity on the part with a volume clear operation. You'll experiment with changing the speeds and feeds, and the clearance plane.

Because the cavity represents a closed volume, unlike the face in the previous step, you'll also have to change the cut pattern.



What: Create a volume clear operation to rough out the cavity.

How:

NC Job Planning form

OpGroup–1

OpGroup Specification form

Deselect *Face Mill Face* by pressing the Control key and selecting *Face Mill Face*.

Operation Selection form

Category: Milling

Type: Volume Clear

Create

Don’t close the Operation Specification form.

What: Select the cavity to rough out. Then preview the stock. You'll use a bounding box for this operation, also.

How: Remember to hold the Shift key as you pick the nine surfaces composing the cavity.

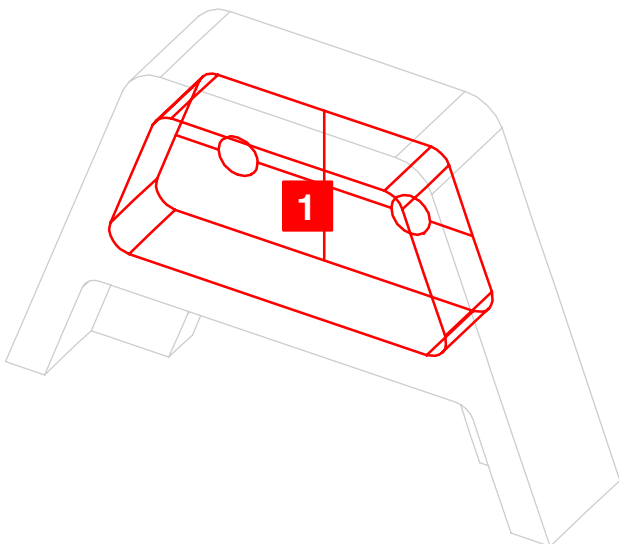
Operation Specification form

Name: Volume Clear Cavity

Stock Specification form

Deselect All

1 Double–click on F31 to select the cavity.



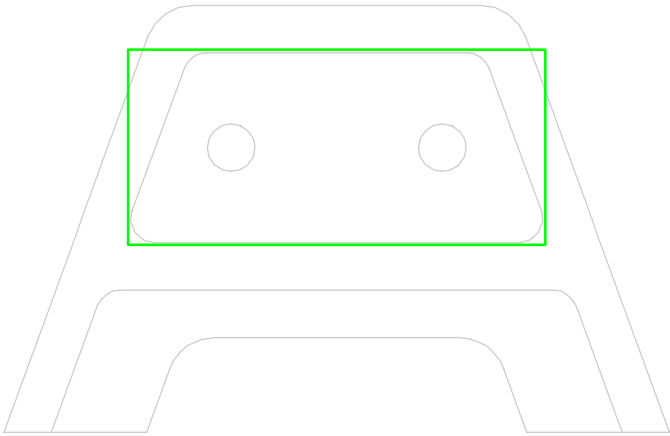
Don't close the Stock Specification form.

What: Preview the stock.

How:

Stock Specification form

Set Stock Area To: *Bounding Box*



Things to notice

Because the cavity has depth, multiple bounding boxes extend from the outer edges of the selected surfaces. Also, the software retained your values for the top and bottom of the stock from the previous operation and calculated the size of the stock for this operation from your selected surfaces.

OK

Don’t close the Operation Specification form.

What: Get a tool to rough out the cavity.

How:

Operation Specification form

Cutting Tool Specification—Mill form

Find...

Item Selection form

1/2” dia End Mill

OK

Cutting Tool Specification—Mill form

OK

Don’t close the Operation Specification form.

What: Set the machining parameters. You change the cut pattern to spiral out so that the walls of the cavity are also machined with the last pass.

The software generates the axial depths for the selected surfaces automatically. You can use this technique to modify the depths. In this step, you'll preview the depths instead. Notice that the critical depth at –0.97 represents the selected bottom of the cavity, or the critical surface.

How:

Operation Specification form

Machining Parameters: Cut form

 *Stepover Distance*: 40

 *Cut Type: Climb*

 *Axial Depths...*

Axial Depths form

 *Generate Depths*

 *OK*

 Don't close the Machining Parameters form.

What: Specify the feeds and speeds.

- IPR stands for inches per revolution.
- SFM stands for surface feet per minute.

How:

Machining Parameters: Cut form


Cut
Feeds and Speeds

Machining Parameters: Feeds and Speeds form


IPM
IPR


Entry—On


Entry: 0.005


Slow: 0.002


Fast: 0.01


Exit—On


Exit: 0.025


Spindle Speed: 80


RPM
SFM


Don’t close the Machining Parameters form.

What: Set the clearance plane 0.2 inches above the part. Then enter .03 in *Default Finish Allowance* to leave .03 inches of material on the walls of the pocket. Toggle on *Floor Finish Allowance* and accept the default of zero. This determines that no material will be left on the floor of the cavity.

How:

Machining Parameters: Feeds and Speeds form


Feeds and Speeds
Clearance

Machining Parameters: Clearance form


Retract to Maximum Z Plus Clearance:


0.2


Clearance
Allowances and Tolerances

Machining Parameters: Allowances/Tolerances form


Default Finish: 0.03


Allowances Applied In: 2D


Floor Finish: 0.0

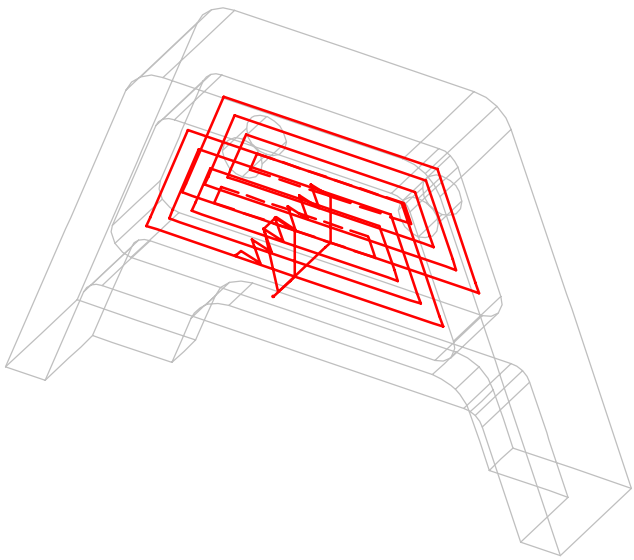

OK


Don’t close the Operation Specification form.

What: Generate the toolpath.

How:

Operation Specification form

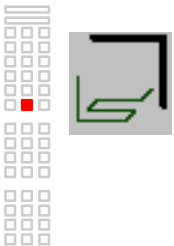


Things to notice

The toolpath contains two depths, with the lowest pass representing the critical depth. Notice the spiral-out cut pattern on the toolpath.

What: Change the display of the toolpath to view all motions with a slow feedrate.

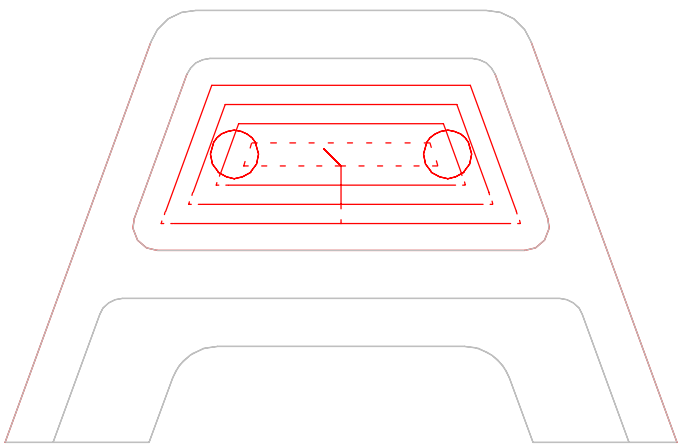
How:



Toolpath Display Options form

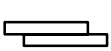
Slow: — — —

OK



Warning!
Don't delete this model file once you're finished. You'll use this model file and job in the next tutorial.

Recovery Point



File
Save

Tutorial wrap-up

You've completed the Creating Face Mill and Volume Clear Operations tutorial.